from wrapping about the tubular shi[redacted]nd impeding flow through the pump.

The vertical turbine pump of the present invention having three impeller vanes and three diffuser vanes achieves very favorable hydraulic performance, as shown in FIG. **6** by the head versus flow curves which slope downwardly from left to right and the iso-efficiency curves which are labelled with percentages. (The curves were obtained from testing of a pump having a twelve inch diffuser exit.) This performance is not achieved by a similarly configured vertical turbine pump having two impeller vanes and two diffuser vanes. In addition, the vertical turbine pump of the present invention, configured with two or three impeller vanes and three diffuser vanes, generates less pronounced pressure pulsations and achieves noticeably smoother operation than a vertical turbine pump having two impeller vanes and two diffuser vanes.

Servicing the pump bowl bearings in the field is simple and straight forward. After removing the pump from its working location and supporting the pump horizontally, the suction bell is separated from the pump bowl casing, the impeller is removed from the end of the drive shaft, the retaining ring **70** within the lower formation **62** in the diffuser core is removed and the bearing cartridge is turned to disengage the threads **64** at the upper end of the tubular housing from the threads **66** in the tubular adapter; the bearing cartridge can then be removed through the lower end of the pump bowl casing and replaced with another bearing cartridge having new or reconditioned bearings. The use of a special tool having an end formation which mates with the formation at the lower end of the bearing cartridge facilitates turning of the bearing cartridge during removal and installation.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

We claim:

sub a1

1. A vertical turbine pump comprising:

a pump bowl assembly including a casing having a bulbous diffuser section between axially opposed upstream and downstream sections which are narrower than said diffuser section;

a bulbous diffuser core disposed centrally in said casing diffuser section;

a drive shaft extending centrally and axially through said diffuser core;

a rotary impeller fastened to an end of said drive shaft and disposed in said casing upstream section adjacent a fluid inlet, said impeller incorporating flared shrouds which are axially spaced from each other and spirally oriented impeller vanes disposed between said shrouds and spaced from each other equiangularly about the axis of impeller rotation;

three stationary diffuser vanes spaced equiangularly about said diffuser core, said diffuser vanes extending laterally between said diffuser core and said casing and having upstream ends which curve about said diffuser core and downstream ends which extend generally axially through said casing downstream section; and

a bearing cartridge separably fastened within said diffuser core, said bearing cartridge carrying axially spaced bearings which surround and rotatably support said drive shaft.

2. A vertical turbine pump as recited in claim **1**, wherein said impeller incorporates three equiangularly spaced impeller vanes.

3. A vertical turbine pump as recited in claim 1, wherein said impeller incorporates two equiangularly spaced impeller vanes.

4. A vertical turbine pump as recited in claim 1, wherein:

said bearing cartridge comprises a tubular housing surrounding said drive shaft, and said bearings are fixed within said tubular housing.

5. A vertical turbine pump as recited in claim 4, wherein:

said tubular housing is fastened within said diffuser core by a threaded coupling.

6. In a vertical turbine pump incorporating a pump bowl assembly including a casing having a bulbous diffuser section between axially opposed upstream and downstream sections which are narrower than said diffuser section, a bulbous diffuser core disposed centrally in said casing diffuser section, a drive shaft extending centrally and axially through said diffuser core and a rotary impeller fastened to an end of said drive shaft and disposed in said casing upstream section adjacent a fluid inlet, the improvement comprising:

a bearing cartridge separably fastened within said diffuser core;

said bearing cartridge carrying axially spaced bearings which surround and rotatably support said drive shaft.

7. In a vertical turbine pump as recited in claim 6, the improvement further comprising:

said bearing cartridge comprising a tubular housing surrounding said drive shaft, and said bearings being fixed within said tubular housing.

8. In a vertical turbine pump as recited in claim 7, the improvement further comprising:

said tubular housing being fastened within said diffuser core by a threaded coupling.

9. In a vertical turbine pump as recited in claim 8, the improvement further comprising:

said threaded coupling comprising threads carried on said tubular housing.

10. In a vertical turbine pump as recited in claim 7, the improvement further comprising:

said tubular housing being fastened to a tubular adapter which surrounds said drive shaft and axially abuts an end surface of said diffuser core which faces downstream.

11. In a vertical turbine pump as recited in claim 10, the improvement further comprising:

said tubular housing being fastened to said tubular adapter by mating threads carried on said tubular adapter and on an end of said tubular housing.

12. In a vertical turbine pump as recited in claim 11, the improvement further comprising:

a formation provided on said end surface of said diffuser core which mates with a formation carried on an end surface of said tubular adapter to effect axial alignment and prevent relative rotation between said tubular adapter and said diffuser core.

13. In a vertical turbine pump as recited in claim 12, the improvement further comprising:

said mating formations comprising axially extending lugs.

14. In a vertical turbine pump as recited in claim 7, the improvement further comprising:

a formation provided on an end of said tubular housing adjacent to said impeller, said formation adapted to mate with a tool for facilitating the removal and installation of said tubular housing through said casing upstream section.

15. ~~A pump comprising:~~

a pump assembly including a casing;

a diffuser core disposed in said casing;

a drive shaft extending through said diffuser core;

a rotary impeller fastened to an end of said drive shaft; and

a bearing separably fastened within said casing, said bearing supporting said drive shaft, said bearing being readily removable from an upstream section of said casing.

16. The pump as recited in claim 15, wherein an only active element removed to allow removal of said bearing is said impeller.

17. The pump as recited in claim 15, wherein said bearing is further separably fastenable within said diffuser core.

18. The pump as recited in claim 15, further comprising a bearing cartridge for housing said bearing.

19. The pump as recited in claim 18, wherein said bearing cartridge includes an engagement structure integral therein and said diffuser core includes a reciprocal engagement structure thereon for receiving the engagement structure of said bearing cartridge.

20. An apparatus for facilitating servicing of a bearing in an upstream end of a pump incorporating a pump assembly including a casing, a diffuser core disposed in the casing, a drive shaft extending through the diffuser core, and a rotary impeller fastened to an end of the drive shaft, the apparatus comprising a bearing separably fastened within the casing, said bearing supporting the drive shaft, the bearing being readily removable from an upstream end of the casing.

21. The apparatus as recited in claim 20, wherein an only active element removed to allow removal of said bearing is the impeller.

22. The apparatus as recited in claim 20, wherein said bearing is further separably fastenable within the diffuser core.

23. The pump as recited in claim 20, further comprising a bearing cartridge for housing said bearing.

24. The apparatus as recited in claim 23, wherein said bearing cartridge includes an engagement structure integral therein and said diffuser core includes a reciprocal engagement structure thereon for receiving the engagement structure of said bearing cartridge.